TABLE 1: BENTOMAT® CL CERTIFIED PROPERTIES

TERIAL PROPERTY	TEST METHOD	TEST FREQUENCY $ft^2(m^2)$	REQUIRED VALUES
ıtonite Swell Index[1]	ASTM D 5890	1 per 50 tonnes	24 mL/2g min.
ıtonite Fluid Loss [1]	ASTM D 5891	1 per 50 tonnes	18 mL max.
ıtonite Mass/Area[2]	ASTM D 5993	40,000 ft^2(4,000 m^2)	0.75 lb/ft^2(3.6 kg/m^2)min
L Grab Strength[3]	ASTM D 4632 ASTM D 6768	200,000 ft^2 (20,000 m^2)	120 lbs (530 N) 30 lbs/in (53 N/cm)
L Peel Strength[3]	ASTM D 4632 ASTM D 6496	40,000 ft^2 (4,000 m^2)	15 lbs (65 N) 2.5 lbs/in (4.4 N/cm)
L Index Flux[4]	ASTM D 5887	Periodic	1 x 10^{-9} m^3/m^2/sec max
L Hydraulic Conductivity[4]	ASTM D 5887	Periodic	5 x 10^{-10} cm/sec max
L Hydrated Internal ear Strength[5]	ASTM D 5321 ASTM D 6243	Periodic	500 psf (24 kPa) typical

Bentomat CL is a reinforced GCL consisting of a layer of sodium bentonite between two geotextiles, which are needlepunched together and laminated to a thin flexible membrane liner.

Notes

1 Bentonite property tests performed at a bentonite processing facility before shipment to CETCO's GCL production facilities.

2 Bentonite mass/area reported at 0 percent moisture content.

3 All tensile strength and peel strength testing is performed in the machine direction using 4 inch grips per modified ASTM D 4632. Results are reported as minimum average roll values unless otherwise indicated. Upon request, tensile strength can be reported per ASTM D 6768 and peel strength can be reported per ASTM D 6496.

4 ASTM D5887 Index flux and hydraulic conductivity testing with deaired distilled/deionized water at 80 psi cell pressure, 77 psi headwater pressure and 75 psi tailwater pressure. Reported value is equivalent to 92 gal/acre/day. This flux value is equivalent to a permeability of $5x10^{-10}$ *cm/sec for typical GCL thickness. ASTM D 5887 testing is performed only on a periodic* basis because the membrane is essentially impermeable.

5 Peak value measured at 200 psf normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

TABLE #2: CLAYMAX® 600CL CERTIFIED PROPERTIES

MATERIAL PROPERTY	TEST METHOD	TEST FREQUENCY $ft^2(m^2)$	REQUIRED VALUES
Bentonite Swell Index[1]	ASTM D 5890	1 per 50 tonnes	24 mL/2g min.
Bentonite Fluid Loss[1]	ASTM D 5891	1 per 50 tonnes	18 mL max.
Bentonite Mass/Area[2]	ASTM D 5993	40,000 ft^2 (4,000 m^2)	0.75lb/ft^2(3.6kg/m^2)
GCL Grab Strength[3]	ASTM D 4632 ASTM D 6768	200,000 ft^2 (20,000 m^2)	75lbs(330 N)18.75 lbs/in (33N/cm)
GCL Peel Strength[3]	ASTM D 4632 ASTM D 6496	N/A	N/A
GCL Index Flux[4]	ASTM D 5887	Periodic	$1x10^{-9}m^3/m^2$/sec max
GCL Hydraulic Conductivity[4]	ASTM D 5887	Periodic	$5x10^{-10}$ cm/sec max
GCL Hydrated Internal Shear Strength[5]	ASTM D 5321 ASTM D 6243	Periodic	50 psf (2.4 kPa) typical

Claymax 600CL is an unreinforced GCL consisting of a layer of sodium bentonite between a geotextile, and a laminate comprised of a geotextile and a polyethylene membrane which are continuously adhered together.

Notes

1 Bentonite property tests performed at a bentonite processing facility before shipment to CETCO's GCL production facilities.

2 Bentonite mass/area reported at 0 percent moisture content.

3 All tensile strength testing is performed in the machine direction using 4 inch grips per modified ASTM D 4632. Results are reported as minimum average roll values unless otherwise indicated. Upon request, tensile strength can be reported per ASTM D 6768.

4. ASTM D 5887 Index flux and hydraulic conductivity testing with deaired distilled/deionized water at 80 psi cell pressure, 77 psi headwater pressure and 75 psi tailwater pressure. Reported value is equivalent to 92 gal/acre/day. This flux value is equivalent to a permeability of $5x10^{-10}$ cm/sec for typical GCL thickness. ASTM D 5887 testing is performed only on a periodic basis because the membrane is essentially impermeable.

5 Peak value measured at 200 psf normal stress for a specimen hydrated for 48 hours. Site-specific materials, GCL products, and test conditions must be used to verify internal and interface strength of the proposed design.

2.4 Product Labeling

A. Prior to shipment, the GCL manufacturer shall label each roll, identifying:

1. Product identification information (Manufacturer's name and address, brand product code).

2. Lot number and roll number.

3. Roll length, width and weight.

2.5 Packaging

A. The GCL shall be wound around a rigid core whose diameter is sufficient to facilitate handling. The core is not necessarily intended to support the roll for lifting but should be sufficiently strong to prevent collapse during transit.

B. All rolls shall be labeled and bagged in packaging that is resistant to photodegradation by ultraviolet UV light.

2.6 Accessory Bentonite

A. The granular bentonite sealing clay used for overlap seaming, penetration sealing and repairs shall be made from the same natural sodium bentonite as used in the GCL and shall be as recommended by the GCL manufacturer. Seaming of GCLs shall be conducted in accordance with the manufacturer's specifications for each particular GCL. Please refer to the installation guidelines for Bentomat/Claymax GCLs.

2.7 TESTS, INSPECTIONS, AND VERIFICATIONS

2.7.1 Manufacturing Sampling and Testing

GCL and its components shall be sampled and tested in accordance with the manufacturer's approved QC manual. The manufacturer's QC procedures shall be in accordance with ASTM D 5889. Test results not meeting the
requirements specified in Table 1 and Table 2 for the appropriate GCL shall result in the rejection of applicable rolls. The manufacturer's QC manual shall describe procedures used to determine rejection of applicable rolls. As a minimum, rolls produced immediately prior to and immediately after the failed roll shall be tested for the same failed parameter. Testing shall continue until a minimum of three successive rolls on both sides of the original failing roll pass the failed parameter.

PART 3 EXECUTION

3.1 SAMPLES AND TESTS

3.1.1 Samples

QC samples shall be collected by the Contractor at approved locations upon delivery to the site at the request of the Engineer. Samples shall be collected, packaged, and transported in accordance with ASTM D 6072. Samples shall be identified with a waterproof marker by manufacturer's name, product identification, lot and roll number. The date, a unique sample number, the machine direction, and the top surface of the GCL shall also be noted on the sample. The outer layer of the

GCL roll shall be discarded prior to sampling a roll. Samples shall then be collected by cutting the full-width of the GCL sheet a minimum of 3 feet wide in the machine direction.

An additional 24 by 24 inch QA sample shall be collected, labeled, and submitted to the Engineer each time QC samples are collected.

3.1.2 Conformance Tests

The Contractor shall provide QC samples to the QC laboratory to determine bentonite mass per unit area (ASTM D 5993) peel strength (ASTM D 6496), flux (ASTM D 5887) and tensile strength (ASTM D 6768) at a frequency of one per 10,000 square feet of CCL placed at the request of the Engineer. Tests not meeting the requirements specified in Table 1 or Table 2 shall result in the rejection of applicable rolls. Determination of applicable rolls shall be as described in paragraph Tests, Inspections and Verifications.

3.2 INSTALLATION

3.2.1 Subsoil Preparation (Imported Natural Compacted Clay liner)

The subsoil shall be a minimum of 1 foot of imported natural imported compacted clay liner (CCL)as shown on the project plans meeting IEPA and USEPA requirements for natural compacted clay liners (CCLs)given in Section 02350 For Imported Natural Compacted Clay Liner for Detention Pond and be compacted in accordance with Section 02350. The subsoil surface shall be smooth and free of vegetation, standing water, and angular stones or other foreign matter that could damage the GCL. Once compacted using a sheepsfoot compactor to minimum compaction requirements given in Section 02350, the subsoil surface shall be rolled with a smooth-drum compactor of sufficient weight to remove any wheel ruts, footprints, or other abrupt grade changes. All protrusions extending more than 0.5 inch from the subsoil surface (or less if recommended by the manufacturer) shall either be removed, crushed, or pushed into the surface with the smooth-drum compactor. Each day during placement, the Engineer (or his authorized representative) and installer shall inspect the surface on which GCL is to be placed and certify in writing that the surface is acceptable.

3.2.2 Placement

GCL shall be installed as soon as practical after completion and approval of the subsoil. Rolls shall be delivered to the work area in their original packaging. Immediately prior to deployment, the packaging shall be carefully removed without damaging the GCL. GCL which has been hydrated prior to being covered by a temporary waterproof tarpaulin or a minimum of 12 inches of cover soil shall be removed and replaced. Hydrated GCL is defined as having become soft as determined by squeezing the material with finger pressure or material which has exhibited swelling. If the subsoil is soil, construction equipment may be used to deploy GCL. If the subsoil is a geosynthetic, GCL shall be deployed by hand or by use of approved light weight equipment with pneumatic tires which will not damage the underlying geosynthetic. On side slopes, GCL shall be anchored at the top
and deployed down the slope to minimize wrinkles. Dragging of GCL panels over the ground surface shall be minimized. The Contracting has the option of requiring the use of a slip sheet. Deployed GCL panels shall lie flat on the subsoil surface, with no wrinkles or folds.

3.2.3 Anchor Trench

Where anchor trenches are required, they shall be placed a minimum of 36 inches back from the edge of slopes to be covered. Anchor trenches shall be a minimum of 36 inches deep and 18 inches wide (see project plans). The front edge of the trench shall be rounded so as to eliminate sharp corners that could damage the GCL. The GCL shall extend down the front wall and across the bottom of the anchor trench. Clay soils used for backfill meeting the requirements in Section

02350 shall have a maximum particle size of 1.0 inch and shall be placed in loose 8 inch lifts with each lift compacted to the minimum percent compaction requirement given in section 02350. Anchor trench clay fill soils will have to be compacted using a hand pushed tamper so as not to damage the underlying GCL.

3.2.4 Seams

On side slopes, GCL shall be placed with seams oriented parallel to the line of maximum slope and shall be free of tension or stress upon completion of installation. Panels shall be positioned with the overlap recommended by the manufacturer, but not less than 6 inches for panel sides or 18 inches for panel ends. Soil or other foreign matter shall be removed from the overlap area immediately prior to seaming. If recommended by the manufacturer, granular bentonite of the same type as the bentonite used for the GCL shall be placed along the entire overlap width at a minimum rate of 0.25 lbs/linear foot or as recommended by the manufacturer. Bentonite enhanced seams are required for the installation of Bentonite CL. Construction adhesive or other approved seaming methods recommended by the manufacturer shall be used for horizontal seams on slopes. Overlaps which occur on slopes shall be constructed with the up slope GCL shingled over the down slope GCL to prevent potential for runoff flow to enter the overlap zone. Alternate seaming methods may be approved if recommended by the manufacturer.

3.2.5 Protection

Only those GCL panels which can be anchored and covered with a temporary waterproof tarpaulin or a minimum of 12 inches of approved topsoil cover (see section 02350) in the same day shall be unpackaged and installed. If exposed GCL cannot be permanently covered before the end of a working day, it shall be temporarily covered with a waterproof tarpaulin or other waterproof material to prevent hydration.

3.3 REPAIRS

Holes or tears in GCL shall be repaired by placing a patch of GCL extending a minimum of 12 inches beyond the edges of the hole or tear on all sides. If recommended by the manufacturer, granular bentonite or bentonite mastic shall be applied in the overlap area. Patches shall be secured with a construction adhesive or other approved methods as recommended by the manufacturer.

3.4 PENETRATIONS

Penetration details shall be as recommended by the GCL manufacturer. As a minimum, pipe penetrations shall incorporate a collar of GCL wrapped around the pipe and securely fastened. Dry bentonite or bentonite paste shall be placed around the penetration as recommended by the GCL manufacturer.

3.5 COVERING

GCL shall not be covered prior to inspection and approval by the Engineer. Immediately after approval, either a temporary waterproof tarpaulin or cover soil must be placed over the GCL. Cover soil shall consist of approved topsoil meeting the requirements given in Section 02350 and be free of angular stones or other foreign matter which could damage the GCL. The maximum particle size of the cover soil shall be 1 inch. Cover soil shall not be dropped directly onto the GCL from a height greater than 3 feet. The soil shall be pushed out over the GCL in an upward tumbling motion. The direction of backfilling shall proceed in the direction of down gradient shingling of GCL overlaps; except that on side slopes, soil backfill shall be placed from the bottom of the slope upward. Cover soil shall be placed such that soil does not enter the GCL overlap zone and tensile stresses are not mobilized in the GCL. No equipment shall be operated on the top surface of the GCL without approval from the GCL manufacturer and permission from the Engineer. The initial loose soil lift thickness shall be 12 inches. If a temporary waterproof tarpaulin is utilized it should be placed by hand. Soil cover shall be placed over the GCL using construction equipment that minimizes stresses on the GCL. A minimum thickness of 1 foot of cover should be maintained between the

equipment tires/tracks and the GCL at all times during the covering process. This thickness recommendation does not apply to frequently trafficked areas or roadways for which a minimum of 2 feet is required. Although direct vehicular contact with the GCL is to be avoided, lightweight, low ground pressure vehicles (such as 4-wheel all-terrain vehicles) may be used only if it is approved by GCL manufacturer and permitted by the Engineer. The GCL supplier should be contacted with specific recommendations on the appropriate procedures in this situation. Equipment placing cover soil shall not stop abruptly, make sharp turns, spin their wheels, or travel at speeds exceeding 5 mph. Cover soil compaction and testing requirements are described in Section 02350.

SECTION 02620A
SUBDRAINAGE SYSTEM

PART 1 GENERAL

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SECTION 02620A
SUBDRAINAGE SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM C 14	(2003) Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 150	(2002ae1) Portland Cement
ASTM C 478	(2003) Precast Reinforced Concrete Manhole Sections
ASTM C 654	(2003) Porous Concrete Pipe

1.2 SUBMITTALS

Approval from Robinson Engineering, Ltd., the Engineer is required for submittals with "R" designation; submittals not having a "R" designation are for Contractor Quality Control Approval. The following shall be submitted:

SD-04 Samples

Filter Fabric; "R"
Pipe for Subdrains; "R"

Samples of filter fabric, pipe, and pipe fittings, before starting the work.

SD-07 Certificates

Filter Fabric; "R"
Pipe for Subdrains; "R"

Certifications from the manufacturers attesting that materials meet specification requirements. Certificates are required for drain pipe and filter fabric.

1.3 DELIVER, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with minimum handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. During shipment and storage, filter fabric shall be wrapped in burlap or similar heavy duty protective covering. The storage area shall protect the fabric from mud, soil, dust, and debris. Filter fabric materials that are not to be installed immediately shall not be stored in direct sunlight.

1.3.2 Handling

Materials shall be handled in such a manner as to insure delivery to the trench in sound undamaged condition. Pipe shall be carried and not dragged to the trench.

1.4 MEASUREMENT AND PAYMENT

1.4.1 Pipe Subdrains

The length of pipe installed will be measured from end to end along the centerlines without any deduction for the diameter of the manholes. Payment for bedding and filter materials, except filter fabric, will be included in the contract unit price per FOOT for PIPE UNDERDRAINS of the size indicated on the plans.

1.4.2 Manholes

Manholes shall be paid for at the contract unit price per EACH for MANHOLES, SPECIAL which payment shall include the base, rungs or ladders, and water tight cast iron frames and water tight covers (East Jordan Iron Works, Inc., Model 1051-1 or equivalent). (See Plans for Details)

1.4.3 Filter Fabric

This work shall be paid for at the contract unit cost per SQUARE YARD for FILTER FABRIC. Overlapped joints and seams shall be measured as a single layer of cloth.

PART 2 PRODUCTS

2.1 PIPE FOR SUBDRAINS

Pipe for subdrains shall be of the types and sizes indicated on project plans.

2.1.1 Porous Concrete Pipe

Porous concrete pipe shall conform to ASTM C 654, standard or extra strength as indicated and using ASTM C 150 portland cement Type IIA.

2.2 FILTER FABRIC

Filter fabric shall be a pervious sheet of polyester, nylon, or polypropylene filaments woven or otherwise formed into a uniform pattern with distinct and measurable openings. The filter fabric shall provide an equivalent opening size (AOS) no finer than the US Standard Sieve No. 120 and no coarser than the US Standard Sieve No. 50. AOS is defined as the number of the US Standard sieve having openings closest in size to the filter fabric openings. The percent open area provided

shall not be less than 4 percent and not more than 36 percent. Percent open area is defined as the summation of open areas divided by the total area of the filter fabric and expressed as a percent. The filaments shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of propylene, ethylene, or vinylidene-chloride, and shall contain stabilizers and/or inhibitors added to the base plastic to make the filaments resistant to deterioration due to ultraviolet and heat exposure.] The fabric shall have a minimum physical strength of 100 pounds per inch in any direction when tested in accordance with ASTM D 5034 using the grab test method with 645.2 1 square inch jaws and a constant rate of travel of 12 inches per minute. Elongation at failure shall be between 15 and 35 percent. The fabric shall be constructed so that the filaments will retain their relative position with respect to each other. The edges of the fabric shall be selvaged or otherwise finished to prevent the outer material from pulling away from the fabric. The fabric shall be woven into a width that may be installed as shown without longitudinal seams.

2.3 DRAINAGE STRUCTURES

2.3.1 Mortar

Mortar for pipe joints and connections to other drainage structures shall be composed of one part by volume of portland cement and two parts of sand. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of injurious acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes from the time the ingredients are mixed with water.

2.3.2 Manholes and Appurtenances

2.3.3.1 Precast Concrete Manhole Bases

If precast concrete manhole bases are used, the bases shall conform to ASTM C 478 and shall be of such a design as to effect suitable connection with influent and effluent lines and to provide a suitable base structure.

2.3.3.2 Water Tight Frames and Covers

The cast iron frame and cover shall be a water tight cast iron frame and cover (East Jordan Iron Works, Inc., Model 1051-1 or equivalent). Water tight frames and covers shall be of cast iron with tensile strength test not less than ASTM A 48M ASTM A 48 Class 25. Weight, shape, and size shall be as indicated on the project plans and details.

2.4 SUBDRAIN FILTER AND BEDDING MATERIAL

Subdrain filter and bedding material shall be pea gravel composed of hard, tough, durable particles free from adherent coatings. Filter material shall not contain corrosive agents, organic matter, or soft, friable, thin, or elongated particles and shall be evenly graded between the limits specified in TABLE I. Gradation curves will exhibit no abrupt changes in slope denoting skip or gap grading. Filter materials shall be clean and free from soil and foreign materials. Filter blankets found to be dirty or otherwise contaminated shall be removed and replaced with material meeting the specific requirements, at no additional cost to the Engineer.

TABLE I. FILTER MATERIAL GRADATION

Sieve Designation	Specific range % Passing by Weight
12.5mm (1/2")	100%
9.5mm (3/8")	85-100
4.75mm (#4)	10-30
2.36mm (#8)	0-10
1.18 (#16)	0-5

PART 3 EXECUTION

3.1 EXCAVATION AND BEDDING FOR SUBDRAIN SYSTEMS

Trenching and excavation for the construction of the under drains shall be performed by the contractor using a backhoe to the bottom of filter material elevation. Pea gravel bedding material meeting gradations specified in Table 1 shall be placed in the trench if required as
replacement materials used in those areas where unstable materials as determined by the onsite field project Geotechnical Engineer are
removed. Compaction of the bedding material shall be saturated by jetting to obtain the required density specified by the field Geotechnical Engineer.

3.2 MANHOLES AND FLUSHING AND OBSERVATION RISERS

3.2.1 Manholes

Manholes shall be installed complete with water tight frames and covers at the locations and within the limits and sizes as indicated on the project plans and details. Manholes shall be constructed as shown on the project plans and details and be of the materials specified for manholes in paragraph DRAINAGE STRUCTURES.

2.3 DRAINAGE STRUCTURES

Joints shall be completely filled and shall be smooth and free of surplus mortar on the inside of the structure. Base for manholes shall be either precast or cast in place of concrete.

3.3 INSTALLATION OF FILTER FABRIC AND PIPE FOR SUBDRAINS

3.3.1 Installation of Filter Fabric

3.3.1.1 Trench Lining and Overlaps

Trenches to be lined with filter fabric shall be graded to obtain smooth side and bottom surfaces so that the fabric will not bridge cavities in the soil or be damaged by projecting rock. The fabric shall be laid flat but not stretched on the soil, and it shall be secured with anchor pins. Overlaps shall be at least 6 inches, and anchor pins shall be used along the overlaps.

3.3.2 Installation of Pipe for Subdrains

3.3.2.1 Pipelaying

Each pipe shall be carefully inspected before it is laid. Any defective or damaged pipe shall be rejected. No pipe shall be laid when the trench conditions or weather is unsuitable for such work. Localized water accumulated at the bottom of the trenches from rainfall on surface runoff shall be removed from trenches by sump pumping or other approved methods. The pipe shall be laid to the grades and alignment as indicated. All pipes in place shall be approved before backfilling.

3.3.2.2 Jointings

Porous Concrete Pipe: Porous concrete pipe shall be installed with mortar joints.

3.4 INSTALLATION OF FILTER MATERIAL AND BACKFILLING FOR SUBDRAINS

After pipe for subdrains has been laid, inspected, and approved, pea gravel filter material shall be placed a minimum of 6 inches around and over the pipe as shown on project plans and details. The pea gravel filter material shall be placed in loose layers not to exceed 8 inches thick, and each layer shall be saturated by jetting to obtain the required density in the field. The placement and compaction of overlying on-site poorly graded fine sand backfill material on the top of the filter fabric which covers the top 6 inches of pea gravel filter material over the pipe to the bottom of the compacted clay liner (as shown in both compacted *clay liner (CCL) and composite geosynthetic clay liner/compacted clay liner (GCL/CCL) detention pond* alternatives) shall be placed in loose 8 inches lifts (see plans and details). Each fine sand backfill lift placed in the trench excavations on the top of the filter fabric and below the compacted clay liner shall be compacted using a portable tamper to a minimum of 85% of the maximum dry density as determined by the Standard Proctor Test (ASTM D 698-00).

3.5 TESTS

3.5.1 Pipe Test

Strength tests of pipe shall conform to field service test requirements of the ASTM specification covering the porous concrete pipe (see paragraph PIPE FOR SUBDRAINS).

3.5.2 On Site Geotechnical Engineer

A representative of the Geotechnical Engineer shall be present during the excavation and placement of under drain pipes bedding material, filter material, filter fabric and during the backfilling over the pipes to confirm the type and strength of subgrade soils in the bottom of the trenches for the proposed pipe and to test compaction of the backfill material.

SECTION 09999
TEMPORARY DEWATERING
WELLS

PART 1 GENERAL

1.1 CONTRACTOR DESIGN

1.2 DRY CONDITIONS

1.3 *DISPOSAL OF DISCHARGE*

1.4 PAYMENT

1.4.1 Dewatering Inside Area S-B Slurry Wall

1.4.2 Dewatering Localized Areas Outside S-B Slurry Wall

PART 2 DESIGN

2.1 ENGINEER APPROVED DEWATERING PLAN

2.1.2 General Design Criteria - Dewatering Inside S-B Slurry Wall

2.1.3 General Design Criteria - Dewatering Outside of S-B Slurry Wall

2.2 NOTICE TO PROCEED

2.3 CONTRACTOR RESPONSIBILITY

2.3.1 Design

2.3.2 Drainage

2.3.3 Maintaining Dewatered ("Dry") Conditions Until End of Construction Sequence

2.3.4 System Removal

PART 1 GENERAL

1.1 CONTRACTOR DESIGN

The dewatering system shall be designed by the Contractor using accepted and professional methods of design and engineering consistent with the best modern practice.

1.2 DRY CONDITIONS

The dewatering system shall be of sufficient size and capacity as required to control ground and surface water flow into the excavation and to allow all work to be accomplished in the "dry". The dewatering system can be installed and employed only after the complete construction of the soil-bentonite slurry trends cut off wall (see Section 02262A).

1.3 DISPOSAL OF DRAINAGE

The Contractor shall control, by acceptable means, all water regardless of source and shall be fully responsible for disposal of the water. The Contractor shall confine all discharge piping and/or ditches to the available easement or to additional easement obtained by the Contractor. All necessary means for disposal of the water, including obtaining additional easement, shall be provided by the Contractor at no additional cost to the owner.

1.4 PAYMENT

1.4.1 Dewatering Areas Inside Soil-Bentonite (S-B) Slurry Wall.

Payment for the dewatering of the site inside the soil bentonite slurry wall using temporary wells shall be paid for at the contract unit cost per LUMP SUM for DEWATERING, and shall constitute full compensation for furnishing all plant, labor, materials and equipment to dewater the site to "dry" conditions for the total time duration of construction of the under drain (subdrainage) system, the storm water lift station, valve vault, either the composite geosynthetic clay liner (GCL)/compacted clay liner (CCL) or importated natural compacted clay liner (CCL) and the placing of topsoil and seeding of the detention pond. "Dry" conditions are defined as lowering the groundwater table approximately 27 feet from an approximate initial elevation of 613 M.S.L. to 10 feet above the bedrock (bedrock encountered at an approximate elevation of 576 M.S.L.). The approximate dewatered groundwater water elevation is 586 M.S.L.

1.4.2 Dewatering Localized Areas Outside the Slurry Wall.

Payment for temporary dewatering of select areas of the site outside of the slurry wall so the proposed storm sewers, force mains, water mains and subgrade along 171st Street and Park Avenue can be installed shall be paid for at the contract unit price per LUMP SUM for DEWATERING, and shall constitute full compensation for furnishing all plant, labor, materials and equipment to locally dewater the site to approximately 3 feet to 5 feet below the bottom of the proposed pipe such that it can be installed properly.

PART 2 DESIGN

2.1 ENGINEER APPROVED DEWATERING PLAN

Contractor shall obtain the services of a qualified dewatering "Expert" or a firm to provide a detailed plan for dewatering the excavation. Contractor shall submit his or her dewatering plan to the Engineer for review and approval. The material to be submitted shall include , but not be limited to, the following:

(a) The qualifications and experience of the selected dewatering "Expert" or the firm (minimum of 5 years of proven experience in the design of equivalent system required).

(b) Drawings showing the soil conditions, stratification and characteristics; location and size of berms, ditches, and deep wells; piezometers, sumps and discharge lines or ditches.

(c) Capacities of pumps, prime movers, and standby equipment.

(d) Design calculations including design parameters and basis of such parameters, factors of safety, characteristics of pumping equipment, piping, etc.

(e) Detailed description of procedures for installing, maintaining, and monitoring performance of the system throughout the complete duration of "Construction Sequence" shown on the project plans.

2.1.2 General Design Criteria for Dewatering Area Inside Soil Bentonite (S-B) Slurry Wall

A minimum pumping rate of 250 gpm must be selected by the contractor for the submersible pump for each temporary dewatering well. A dewatering time of approximately 2 weeks must be achieved. Each well must be installed from the existing ground level (approximate elevation of 619 M.S.L.) to the top of bedrock encountered at 576 MSL (a total approximate height of 43 feet). The groundwater level to be dewatered inside the area of the completed soil bentonite (S-B) slurry trench cut off wall must be dewatered from the initial groundwater level (approximately 613 MSL) to an approximate groundwater elevation of 586 MSL (approximately 10 feet above the bottom of the top of existing bedrock below.) Each temporary dewatering well must be in compliance with Detail 2 of the project plans and contain a submersible pump capable of pumping minimum of 250 gallons per minute (gpm), a well screen of sufficient slot size, a discharge column pipe or hose, a filter-pack, casing and discharge to an approved area outside of the soil bentonite slurry wall according to paragraph 1.3 DISPOSAL OF DRAINAGE of this section.

A specific design by the Contractor must conform to the general criteria given in the Temporary Dewatering Well Section, however, the specific design (number, size of pumps, actual pumping rate, location inside soil bentonite (S-B) slurry trench cut off wall do not need to conform to the 3 approximate temporary dewatering well locations shown on the project plans if the Contractor can achieve the desired dewatering depth (586 M.S.L.) and time for dewatering (approximately 2 weeks) with his own temporary well system design (including filter-pack, electric submersible pumps, slotted screens, etc.) that must be approved by the Engineer.

2.1.3 General Design Criteria for Localized Dewatering Outside of Soil Bentonite (S-B) Trench Cut Off Slurry Wall.

For the temporary dewatering of the saturated fine sand soils outside of the soil bentonite (S-B) trench cut off slurry wall, the contractor shall submit to the Engineer a design for system of shallow depth axial dewatering wells (6" size or bigger) to lower the existing groundwater elevation of 613 M.S.L. in the vicinity of the proposed storm sewer and force main pipe along 171st Street to a sufficient depth (3 to 5 feet) below the bottom of the proposed pipe inverts prior to installation of the proposed storm sewer lines and force mains and catch basins in this area in order to construct open cut excavations.

This temporary predrainage system should be employed to intercept and remove the groundwater before it can get to the trench excavation prior to its construction and should just lower the water table in that localized area 3 to 5 feet in depth so as not to undermine surrounding embankments or roadways. Shallow depth axial wells with electric submersible pumps are types of predrainage systems that should be employed to dewater the site prior to the construction of the trenches for these utilities.

In the predrainage system, wells are installed a distance outside the perimeter of the trench excavation. The system of wells points extract the groundwater by applying a vacuum to each well. Once the water table is lowered to an acceptable distance beneath the anticipated bottom of the proposed trench excavation as approved

by the Engineer, then the trenches for the storm sewer and force main and catch basins can be excavated and the pipelines constructed in the dry.

Once the storm sewer pipe or force main pipe has been installed and backfilled in accordance with the ISPE "Standard Specification For Water and Sewer Main Construction in Illinois," fifth edition, May 1996, the system of shallow depth axial dewatering wells can be removed.

2.2 NOTICE TO PROCEED

Notice to Proceed issued by the Engineer or receipt of the dewatering plans and data submitted by Contractor shall not in any way be considered to relieve the Contractor from full responsibility for errors therein or from the entire responsibility for complete and adequate design and performance of the system in controlling the groundwater in the excavated areas. The Contractor shall be solely responsible for proper design, installation, operation, maintenance, and any failures of any component of the system.

2.3 CONTRACTOR RESPONSIBILITY

2.3.1 Design

The Contractor shall be responsible for the accuracy of the drawings, design data, and operational records required.

2.3.2 Damage

The Contractor shall be responsible for and shall repair without cost to the Engineer any damage to work in place, other Contractor's equipment, utilities, residences, highways, roads, railroads, private and municipal well systems, and the excavation, that may result from his or her negligence, inadequate or improper design and operation of the dewatering system, and any mechanical or electrical failure of the dewatering system.

2.3.3 Maintaining Dewatered ("Dry") Conditions Until Completion of Construction Sequence.

After the complete construction of the soil bentonite (S-B) slurry trench cut off wall, the temporary dewatering walls inside of said completed cut off wall can be installed and turned on. Once this area inside the soil bentonite (S-B) slurry wall is dewatered to approximately 586 M.S.L. then these temporary dewatering walls shall maintain this "dry" condition during excavation and during the installation of all work in the excavated area inside the soil bentonite slurry wall. The Contractor shall maintain the excavations to a dewatered condition defined as a "dry" condition in paragraph 1.4 of this section. System maintenance shall include but not be limited to 24-hour supervision by personnel skilled in the operation, maintenance, and replacement of system components, and any other work required to maintain the excavation in a dewatered condition for the completion of the "Construction Sequence" shown on the project plans and as described in paragraph 1.4 of this section. Dewatering shall be a continuous operation and interruptions due to outages, or any other reason, shall not be permitted.

2.4 SYSTEM REMOVAL

The Contractor shall remove all dewatering equipment from the site, including related temporary electrical service once the "Construction Sequence" as shown on the plans is completed. All installed temporary dewatering wells shall be cut off a minimum of 2 feet below the final ground surface and filled and sealed with grout per the Illinois Water Well Code to avoid water from infiltrating into the ground.

APPENDIX

A. BORING LOGS

B. GRADATION CURVES

C. MONITORING WELL INSTALLATION DIAGRAMS

D. GROUNDWATER ELEVATION SUMMARY

E. TEMPORARY DEWATERING WELLS

ILLINOIS DEPARTMENT OF TRANSPORTATION
STRUCTURE BORING LOG

Date 3/17/03

STATE _____ DESCRIPTION Proposed Detention Pond, Retaining Wall and Road Reconstruction

COUNTY _____ STRUCTURE NO. () DRILLED BY JL

D.O.T. _____ L.A.F.O. _____

Boring No. B-3
Station _____
Offset _____
Surface El. 617.12 (M.S.L.)

Surf. Wat. El. _____
Groundwater Elev.:
When Drilling 7'
at Completion 6'
After _____ Hrs

DEPTH	BLOWS	QU TSF	W %	DEPTH	BLOWS	QU TSF	W %
6" FILL: SANDY CLAY LOAM, Dark Brown, Some Brown and Black, Trace Fine to Medium Gravel (A-6)							
24" FILL: SAND, Dark Brown and Black, Loose, Moist (A-3)	7		24.3	17.5 SAND, Gray, Fine to Coarse Grained, Very Dense, Saturated (A-3)	52		14.5
2.5 SAND, Brown, Trace Gray, Fine Grained, Loose, Moist (A-3)			16.2	SILT, Gray, Some Fine Gravel, Very Dense, Saturated (A-4)			12.8
SANDY LOAM, Brown, Trace Gray, Fine Grained, Loose, Moist (A-2-4)	8		21.9	20.0			
5.0				22.5			
SANDY LOAM, Gray, Fine Grained, Medium Dense to Loose to Medium Dense, Saturated (A-2-4)	14		24.6	CLAY LOAM, Gray, Trace Fine Sand and Gravel, Very Stiff, Moist (A-6)	14	3.0 P	12.3
7.5				25.0			
10.0							
(Sieve Analysis @ 11')	9		23.4	27.5			
12.5				SILT, Gray, Little Sand, Dense, Saturated (A-4)	33		15.
	12		23.8	End of Boring @ 30 Feet			
				Boring B-3 was offset 6' south from its original boring location due to an existing gas line main. (Driller's Observation)			

S=SS (Split Spoon Sample - 2" O.D. 1 3/8" I.D. 140 pound hammer falling 30" to drive 2" O.D.)
SPT=Split Spoon Sample (2" O.D. 1 3/8" I.D. 140 pound hammer falling 30")

QU=B-Bulge S=Shear P=Penetration Test
Stations, Depths, Offset, and Elevations are in Feet

ILLINOIS DEPARTMENT OF TRANSPORTATION
STRUCTURE BORING LOG

Date 3/14/03

ROUTE ____ DESCRIPTION Proposed Detention Pond, Retaining Wall and Road Reconstruction

SECTION ____ STRUCTURE NO. () DRILLED BY JL

COUNTY ____ LOCATION ____

BORING NO. B-4
STATION ____
OFFSET ____
Surface El. 618.00 (M.S.L.)

Surf. Wat. El. ____
Groundwater Elev.:
When Drilling 9.5'
at Completion 10'
After ____ Hrs

Description	DEPTH	BLOWS	QU TSF	W %
10" FILL: SANDY LOAM, Dark Brown (A-2-4)				
14" FILL: SAND, Dark Brown and Black, Loose, Moist (A-3)		9		25.4
SAND, Brown, Light Brown, Fine Grained, Loose, Moist (A-3)	2.5			6.8
	5.0	9		12.1
SAND, Brown, Fine Grained, Loose, Moist to Saturated (A-3)	7.5	7		11.0
Saturated below 9.5'	10.0			
SAND, Gray, Fine Grained, Trace Fine Gravel, Medium Dense, Saturated (A-3)		10		23.0
	12.5			
		14		22.7
	15.0			

Description	DEPTH	BLOWS	QU TSF	W %
	17.5			
		13		23.8
	20.0			
	22.5			
(Sieve Analysis @ 24')		15		22.[illegible]
	25.0			
	27.5			
		17		20
End of Boring @ 30 Feet	30.0			

N=Standard Penetration Test-Blows per foot to drive 2" O.D. Split Spoon Sampler 12" with 140 pound hammer falling 30"

(QU) B=Bulge S=Shear P=Penetration Test

Stations, Depths, Offset, and Elevations are in Feet

ILLINOIS DEPARTMENT OF TRANSPORTATION
STRUCTURE BORING LOG

Page [illegible] of [illegible]

Date [illegible]

Route ______ Description: Proposed Detention Pond, Retaining Wall and Road Reconstruction

Section ______ Structure No. () ______ Drilled By: JL

County ______ Location ______

Boring No. B-5

Station ______

Offset ______

Surface El. 616.64 (M.S.L.)

Surf. Wat. El. ______

Groundwater Elev.:

When Drilling 6.5'

At Completion 7'

After ____ Hrs

Description	DEPTH	BLOWS	QU TSF	W %
2.5" FILL: SANDY LOAM, Dark Brown and Black, Loose, Moist (A-2-4)				
		7		19.1
	2.5			
SAND, Brown, Trace Light Gray, Fine Grained, Loose, Moist (A-3)				18.2
	5.0	8		23.7
SANDY LOAM, Gray, Fine Grained, Loose to Medium Dense, Moist to Saturated (A-2-4)				
Saturated below 6.5'				
	7.5	10		19.4
	10.0			
(Sieve Analysis @ 11')		13		21.8
	12.5			
		10		22.3
	15.0			

Description	DEPTH	BLOWS	QU TSF	W %
	17.5			
SAND AND GRAVEL, Gray, Fine to Medium Grained, Medium Dense, Saturated (A-1-b)		16		20.
(Sieve Analysis @ 19')				
	20.0			
	22.5			
SILTY LOAM, Gray, Trace Fine Gravel, Dense, Saturated (A-4)		30		18.
	25.0			
	27.5			
		35		20
	30			
End of Boring @ 30 Feet				
Boring B-5 was offset 12' north from its original boring location. (Driller's observation)				

N=Standard Penetration Test (blows per foot to drive 2" O.D. Split Spoon Sampler 12" with 140 pound hammer falling 30")

(Qu) B=Bulge S=Shear P=Penetration Test

Stations, Depths, Offset, and Elevations are in Feet